	Type	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition
1	BRS	414	"TiO.sub.x" and "TiO.sub.2"	USPAT; US-PGPUB	2004/02/20 17:29		
2	BRS	2	("TiO.sub.x" and "TiO.sub.2") and (annealing with "TiO.sub.x")	USPAT; US-PGPUB	2004/02/20 17:21		
3	BRS	60	("TiO.sub.x" and "TiO.sub.2") and ferroelectric	USPAT; US-PGPUB	2004/02/20 15:47		
4	BRS	60	(("TiO.sub.x" and "TiO.sub.2") and ferroelectric) and @ad<20030716	USPAT; US-PGPUB	2004/02/20 16:36		
5	BRS	20	"TiO.sub.x" and (hydrogen with "TiO.sub.2")	USPAT; US-PGPUB	2004/02/20 16:36		
6	BRS	20	("TiO.sub.x" and (hydrogen with "TiO.sub.2")) and @ad<20030716	USPAT; US-PGPUB	2004/02/20 16:42		
7	BRS	17	(("TiO.sub.x" and (hydrogen with "TiO.sub.2")) and @ad<20030716) not ((("TiO.sub.x" and "TiO.sub.2") and ferroelectric) and @ad<20030716)	USPAT; US-PGPUB	2004/02/20 16:42		
8	BRS	13	FeRAM and "TiO.sub.x" and "TiO.sub.2"	USPAT; US-PGPUB	2004/02/20 16:49		
9	BRS	13	(FeRAM and "TiO.sub.x" and "TiO.sub.2") and @ad<20030716	USPAT; US-PGPUB	2004/02/20 16:51		
10	BRS	0	FeRAM and (sidewall with "TiO.sub.x") and "TiO.sub.2"	USPAT; US-PGPUB	2004/02/20 16:49		
11	BRS	0	FeRAM and (sidewall with "TiO.sub.x") and "TiO.sub.2"	EPO; JPO; DERWENT; IBM_TDB	2004/02/20 16:49		
12	BRS	0	ferroelectric and (sidewall with "TiO.sub.x") and "TiO.sub.2"	EPO; JPO; DERWENT; IBM_TDB	2004/02/20 16:50		
13	BRS	0	ferroelectric and (sidewall with "TiO.sub.x") and "TiO.sub.2"	USPAT; US-PGPUB	2004/02/20 16:50		
14	BRS	0	ferroelectric and (sidewall with "TiO.sub.x") and "TiO.sub.2"	USPAT; US-PGPUB	2004/02/20 16:50		

	Type	Hits	Search Text	DBs	Time Stamp	Comments	Error Definition
15	BRS	0	ferroelectric and (sidewall same "TiO.sub.x") and "TiO.sub.2"	USPAT; US-PGPUB	2004/02/20 16:50		
16	BRS	0	ferroelectric and (sidewall same "TiO.sub.x") and "TiO.sub.2"	EPO; JPO; DERWENT; IBM_TDB	2004/02/20 16:51		
17	BRS	14	ferroelectric and sidewall and "TiO.sub.x" and "TiO.sub.2"	USPAT; US-PGPUB	2004/02/20 16:58		
18	BRS	14	(ferroelectric and sidewall and "TiO.sub.x" and "TiO.sub.2") and @ad<20030716	USPAT; US-PGPUB	2004/02/20 17:21		
19	BRS	0	ferroelectric and sidewall and "TiO.sub.x" and "TiO.sub.2"	EPO; JPO; DERWENT; IBM_TDB	2004/02/20 16:58		
20	BRS	25	("TiO.sub.x" and "TiO.sub.2") and ((thermal or heat or heating) with "TiO.sub.x")	USPAT; US-PGPUB	2004/02/20 17:21		
21	BRS	25	(("TiO.sub.x" and "TiO.sub.2") and ((thermal or heat or heating) with "TiO.sub.x")) and @ad<20030716	USPAT; US-PGPUB	2004/02/20 17:29		
22	BRS	181	"TiO.sub.x" same "TiO.sub.2"	USPAT; US-PGPUB	2004/02/20 17:37		
23	BRS	47	("TiO.sub.x" same "TiO.sub.2") and @ad<20030716 and memory	USPAT; US-PGPUB	2004/02/20 17:38		
24	BRS	0	"TiO.sub.x" same "TiO.sub.2"	EPO; JPO; DERWENT; IBM_TDB	2004/02/20 17:38		
25	BRS	0	memory and ("TiO.sub.x" same adhesion)	EPO; JPO; DERWENT; IBM_TDB	2004/02/20 17:38		
26	BRS	28	memory and ("TiO.sub.x" same adhesion)	USPAT; US-PGPUB	2004/02/20 17:38		
27	BRS	28	(memory and ("TiO.sub.x" same adhesion)) and @ad<20030716	USPAT; US-PGPUB	2004/02/20 17:39		

US-PAT-NO: 6645807

DOCUMENT-IDENTIFIER: US 6645807 B2

TITLE: Method for manufacturing semiconductor device

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Brief Summary Text - BSTX (9):
Here, the **adhesion** of the lower electrode 55 to the dielectric film is weak, so that if the lower electrode 55 is formed directly on the interlayer dielectric film 52, then there is the possibility that the lower electrode 55 separates from the interlayer dielectric film 52. To prevent this, the **adhesion** layer 54 made of a metal such as Ti or Ta or an oxide (e.g. TiO.sub.x, TaO.sub.x) or a nitride (e.g. TiN.sub.x, TaN.sub.x) of these metals is arranged between the lower electrode 55 and the interlayer dielectric film 52, thus improving the **adhesion** of the lower electrode 55 to the underlying dielectric film. It should be noted that recently, oxides and nitrides of, for example, titanium aluminum, tantalum silicon or tantalum aluminum have been used as the material for the **adhesion** layer 54.

Brief Summary Text - BSTX (11):
On the other hand, a method of suppressing the diffusion of the **adhesion** layer metal throughout the electrode and the deposition on the electrode surface is conceivable in which a sufficiently oxidized **adhesion** layer is formed first. However, the following problems occur if in the course of forming, for example, a titanium oxide (TiO.sub.x) film as the **adhesion** layer a

Ti film is annealed in an oxidizing atmosphere to form the TiO.sub.x film, or
the TiO.sub.x film is deposited while letting Ti react with oxygen in a vapor
phase, or the TiO.sub.x film is deposited using a reactive sputtering process,
by admixing oxygen when sputtering Ti.

Detailed Description Text - DETX (6):
Next, as shown in FIG. 1C, a metal layer 7A of about 1 to 10 nm thickness
(for example 3 nm) made of, for example, Ti is formed on the third interlayer
dielectric film 5 including the bottom and the walls of the recesses 6. After
that, the metal layer 7A is rinsed with water for about 5 min. For this, a
temperature of 25 to 50.degree. C. is suitable for the rinsing water. Thus,
as shown in FIG. 1D, the metal layer 7A is oxidized, and an **adhesion** layer 7
made of titanium oxide (TiO.sub.x) can be formed. In this situation, if the
thickness of the metal layer 7A is at least 1 nm and not more than 10 nm, then
the metal layer 7A can be sufficiently oxidized by rinsing with water, and the
thusly formed sufficiently oxidized TiO.sub.x film can serve as an **adhesion**
layer 7 with superior **adhesion**. If, on the other hand, the thickness of the
metal layer 7A is less than 1 nm, then a sufficient **adhesion** may not be
attained by the **adhesion** layer 7. Furthermore, if the thickness of the metal
layer 7A is larger than 10 nm, then the metal layer 7A is not sufficiently
oxidized by the rinsing with water, so that metal atoms (Ti atoms) may be
diffused throughout the Pt electrode formed on the **adhesion** layer 7.

Detailed Description Text - DETX (8):
Next, as shown in FIG. 1E, a Pt film 8A of about 20 nm thickness serving as
the lower electrode is formed on the **adhesion** layer 7, for

example by
sputtering, until the recesses 6 are mid-way filled up.
Here, by forming the
Pt film 8A on the third interlayer dielectric film 5
including the recesses 6
with the **adhesion** layer 7 made of TiO.sub.x interposed
between the interlayer
dielectric film and the Pt film 8A, film separation can be
prevented better
than in the case of directly forming the Pt film 8A on the
third interlayer
dielectric film 5 including the recesses 6. Next, using
for example CVD, a
silicon oxide film 9 of about 400 nm thickness is formed on
the Pt film 8A,
completely filling up the recesses 6.

Detailed Description Text - DETX (16):
Furthermore, in this embodiment, TiO.sub.x was used as
the material of the
adhesion layer 7, but there is no particular limitation to
the material of the
adhesion layer 7, as long as it displays the same effect as
TiO.sub.x.
Furthermore, Ti was used as the material of the metal layer
7A that is turned
into the **adhesion** layer 7, but instead it is also possible
to use for example
Ta, TiAl, TiW, TaAl, TiSi or TaSi.